IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
ALASTAIR JAMES BUCHANAN et al.	)	Group Art Unit 3664
	)	
Serial No. 10/713,789	)	Confirmation No. 8772
	)	
Filed: November 14, 2003	)	Examiner Ronnie M. Mancho
	)	
For: SENSING APPARATUS FOR VEHICLES	)	Attorney Docket 1-24912
	)	

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APPELLANTS' BRIEF UNDER 37 C.F.R. § 41.37(d)

Honorable Sir:

This Appeal is taken from the Examiner's Final Rejection of Claims 1-5, 7-14 and 16-23 in the above-identified application. The Notice of Appeal was timely filed on July 24, 2008. Please charge Deposit Account No. 13-0005 in the amount of $510.00 to cover the fee pursuant to 37 C.F.R. 41.20(b)(2).

Respectfully submitted,

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I. Real Party in Interest

The above-identified patent application is owned by Assignee, Lucas Industries Limited, Stratford Road, Solihull, West Midlands, B90 4LA, Great Britain.

II. Related Appeals and Interferences

There are no other appeals or interferences that are known to Appellants, the Appellants' representative, or assignee which will directly affect, be directly affected by, or have a bearing on the Board's decision in this appeal.

III. Status of Claims

Claims 1-5, 7-14 and 16-23 stand rejected. Claims 6 and 15 are cancelled. Claims 1-5, 7-14 and 16-23 are appealed.

IV. Status of Amendments

There have been no amendments to the application after the Final Office Action dated July 21, 2008.

V. Summary of Claimed Subject Matter

The invention is a target vehicle position sensing apparatus for a host vehicle comprising a first data processing apparatus configured to *predict* a target lane in which a host vehicle will be located when it has traveled along a projected path by a distance to the target vehicle.

As claimed in independent claim 1 and disclosed in the specification from line 22 on page 8 to line 8 on page 14, and shown in Figs. 1-6, the target vehicle position sensing apparatus comprises:

a lane detection apparatus provided on the host vehicle (1) which includes an image acquisition apparatus (100) configured to capture an image of at least a part of the road ahead of the host vehicle (1);

a vehicle path estimation apparatus (104) configured to estimate a projected path for the host vehicle (1);

a target vehicle detection apparatus (103) located on the host vehicle (1) which is configured to identify the position of any target vehicles located on the road ahead

of the host vehicle (1), the position including data representing the distance of the target vehicle (2) from the host vehicle (1);

first data processing apparatus (104) configured to predict a target lane in which the host vehicle (1) will be located when it has travelled along the projected path by the distance to the target vehicle (2); and

second processing apparatus (104) configured to compare the position of the target vehicle (2) determined by the target vehicle detection apparatus with the position of the target lane to provide a processed estimate of the actual position of the target vehicle (2).

VI. Grounds of Rejection to be reviewed on Appeal

Grounds of rejection are set forth in the Office Action dated July 21, 2008, as:

Whether claims 1-5, 7-14 and 16-23 are unpatentable under 35 U.S.C. §102(b) as being anticipated by EP 0890470 A2, to Sawamoto et al.

VII. Arguments

Claims 1-5, 7-14 and 16-23 are rejected under 35 U.S.C. §102(b) as being anticipated by EP 0890470 A2, to Sawamoto et al. (hereinafter "Sawamoto").

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v Union Oil Co. of California,* 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v Suzuki Motor Co.,* 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the Appellants' claim. *In re Bond, 15* USPQ2d 1566 (Fed. Cir. 1990).

Claim 1 is drawn to a target vehicle position sensing apparatus for a host vehicle comprising, among other features, a first data processing apparatus configured to *predict* a target lane in which a host vehicle will be located when it has traveled along a projected path by a distance to the target vehicle.

The Examiner states that Sawamoto discloses a target vehicle sensing apparatus comprising a first data processing apparatus configured to predict a target lane

(referring to Sawamoto at the Abstract of Disclosure and Figs. 3 and 4) in which the host vehicle will be located when it has traveled along the projected path by a distance to a target vehicle (also referring to Sawamoto at col. 9, lines 14-44 et. seq., Fig. 7). The Examiner argues with particularity that Sawamoto discloses a processor 62 that clearly predicts the position of a host vehicle in a future path (referring to Sawamoto at col. 9, lines 46 to col. 10, line 11), wherein the processor 62 "predicts" the future path of the host vehicle relative to a target vehicle when the host vehicle has traveled a distance between the host vehicle and the target vehicle (also referring to Sawamoto at col. 9, line 51 and col. 10, lines 5-11) (see the section 2 on pages 2 and 3 of the Office Action dated July 21, 2008).

Contrary to the Examiner's statements above, Sawamoto does not disclose a data processing apparatus that *predicts* the future path of the host vehicle relative to a target vehicle when the host vehicle has traveled a distance between the host vehicle and the target vehicle, as recited in Claim 1. Instead, Sawamoto discloses a lane change detector that detects whether a lane change is *currently occurring* (see Sawamoto at col. 6, lines 5 to 9).

The description of the function of the lane change detector appears between column 6, line 29 to column 7, line 12. This portion of the description cites a number of alternatives for the detection of lane changes. Each of these has in common the fact that they detect whether a lane change is currently occurring. The first option is a measurement of the rate of yaw (col. 6, lines 37 to 51). Sawamoto discloses: "when the yaw rate sensor ... generates a detected signal in excess of the threshold level, the CPU 55 determines that its own vehicle <u>is</u> making a lane change, and issues a lane change signal to the processor 6." Note the use of the word "is" in the present tense. The same section also applies to the steering angle; if it is over a threshold, then the CPU 55 determines the vehicle is making a lane change.

The next option calculates a history of movement of the host vehicle. Sawamoto says: "if a lateral displacement corresponding to a lane change occurs in the calculating history of movement, then the CPU 55 determines that its own

vehicle is making a lane change, and issues a lane change signal to the processor 6" (col. 6, lines 54 to 58). Again, this is to determine whether a lane change is currently occurring. Similarly, where positional information from the navigation system 55 is used (col. 7, lines 1 to 3) the CPU 55 can determine that the host vehicle is making a lane change. The CPU 55 can also determine that its own vehicle is making a lane change based on the operation of a direction of the host vehicle (col. 7, lines 4 to 6). Column 7, lines 9 to 12, states that the CPU 55 determines that the host vehicle is making a lane change from the identified white marking line, the yaw aid or the steering wheel of the host vehicle. All of these features have in common the fact they work out whether the vehicle is currently making a lane change.

Accordingly, the CPU 55 in Sawamoto is not carrying out a prediction. It is required in claim 1 that the first data processing apparatus predict the target lane. "Predict" is defined in The Oxford English Dictionary (see The Oxford English Dictionary, reprinted 1970, page 1261, vol. VIII, Oxford University Press, Oxford, Great Britain) (a copy of the relevant page submitted in an Information Disclosure Statement filed November 27, 2006) as "to say beforehand, foretell..." Accordingly, to predict something is to say beforehand what that something will be in the future. In Appellants' claims, the term "prediction" is qualified by the term "when it has traveled along the projected path by the distance to the target object." This is requiring that the prediction be of the location of the host vehicle when it has traveled along the projected path by the relevant distance. It is not that the prediction is carried out when the host vehicle has traveled along the projected path but that the prediction is of the location where the host vehicle will be (in the future), once it has traveled along the projected path. The Examiner's interpretation of the "when" clause is clearly not what is envisaged by the claim when interpreted in light of the specification (see MPEP §2111.01) (see the section 4 on page 4 of the Office Action dated August 14, 2006). The claims therefore require that the prediction is carried out at a first instance to determine where the

host vehicle will be when it has traveled the appropriate distance. This is quite clearly not carried out in Sawamoto.

In Sawamoto, the processor 6 determines whether a lane change is being carried out based on the signal from the lane change detector 5 as discussed above (col. 7, lines 13, 16, 17 and 19 to 25). If the lane change is happening, then the processor 6 moves the estimated path for its own vehicle in an appropriate direction one lane width (col. 7, lines 26 to 28, col. 8, lines 40 to 44). The processor therefore assumes that the host vehicle will travel in this new lane until another lane change is detected. There is no prediction of the target lane at the distance to the target vehicle.

The Examiner cites column 9, lines 16 to 41 of Sawamoto as showing that Sawamoto discloses a processor for predicting a target lane based on the distance to the vehicle (see the section 6 on page 5 of the Office Action dated August 14, 2006). Respectfully, however, this is incorrect. The following analysis of the cited section of Sawamoto demonstrates that this section does not disclose what the Examiner claims it does. Column 9, lines 16 to 28, describes Figs. 6A and 6B. A host vehicle Z is shown, traveling along a predicted path K1. Note that K1 is not a distance; column 9, lines 25 to 26, states that K1 is an estimated path for the vehicle Z in the present lane. Therefore, it is clear that K1 is not a distance to the target vehicle. The path K1 is inherently in the direction of the proceeding vehicle P because the proceeding vehicle P is ahead of the host vehicle Z in the same lane. Note how there is no disclosure of the distance to the target vehicle P in this section with respect to the definition of path K1 (Col. 9, lines 29 to 32); K1 is independent of this distance.

Column 9, lines 33 to 41, discusses what happens when it is determined that a lane change is currently occurring. The estimated path K1 is moved by the lane width W one lane to the right. As column 9, lines 36 to 38 states, this results in tentative path K2 in the new lane. Thus, the path K2 will always be in the lane to the right or left of the vehicle once a lane change currently in occurrence is detected. There can be no prediction of a target lane at some future point, given

that the path K2 will always be one lane to the right or to the left of the host vehicle; the tentative path is generated such that it is always one lane to the left or the right. This tentative path is generated as of the change of lane. It is not a prediction of lane changes that will happen in anything other than the immediate future whilst the current lane change is occurring.

It is also to be noted that it is only after the tentative path is generated that it is determined whether a vehicle Q is in the new path (col. 9, lines 38 to 41). There is no detection of the distance of the new front vehicle Q in the determination of the tentative path K2. The two predictive paths K1 and K2 are therefore independent of the distance to the target vehicles P and Q. There is nothing in the section cited by the Examiner to state that the prediction is of the target lane in which the host vehicle will be once it has traveled the distance to the target vehicle, instead, the system assumes that the vehicle is either traveling in the same lane or is imminently moving one lane to the left or to the right. There is no prediction of a target lane of anything other than the currently-occurring maneuver.

Sawamoto determines whether the host vehicle is changing lanes based on the lane change detector discussed above. As Appellants have discussed, this determines the host vehicle is currently changing lanes. It does *not*, however, extend this prediction to the lane in which the host vehicle will be in at the required distance. Sawamoto does determine a future path for the vehicle. However, there is no comparison of this to a target lane.

The Examiner cites column 7, lines 29 to 54 as showing a prediction of a target lane for a host vehicle (see the section 6 on page 6 of the Office Action dated August 14, 2006). Column 7, lines 29 to 37 discloses that the processor plots a future path for its own vehicle estimated from vehicle speed and steering angle or yaw rate of the host vehicle. This is therefore a future path for the vehicle. There is no disclosure of comparing this to a target lane. Column 7, lines 38 to 46, adds to this a history of movement of the host vehicle. This adds nothing to the calculation of the future path of the vehicle and again there is no comparison of the future paths to a

target lane. Finally, column 7, lines 47 to 54 discusses the detection of a preceding vehicle on the estimated path. There is no disclosure in this section of any comparison of the future path to a target lane.

Accordingly, Appellants' assertion that Sawamoto does not predict which lane the host vehicle will be in at the required distance still holds valid and the section cited by the Examiner does not disclose any detection of what lane the vehicle will be in after the vehicle has traveled that distance. Furthermore, Appellants' remarks are no way in contradiction. Sawamoto, as discussed above, determines whether a lane change is currently occurring based on the output of a steering rate sensor. This is therefore a consideration of what is currently occurring. Appellants use a yaw sensor in their invention for the prediction of the future path of the vehicle. There is therefore no contradiction in arguments that Sawamoto uses the yaw sensor to determine whether a lane change is currently occurring and the use of a yaw sensor in the present application to determine what lane the vehicle will be in at a defined future point.

The Examiner's analysis of the claims is incorrect. The limitations of the claim in dispute are the first and second data processing apparatus. According to claim 1, the first data processing apparatus is configured to predict a target lane in which the host vehicle will be located when it has travelled along the projected path by the distance to the target vehicle.

Sawamoto may predict a future path for the host vehicle (see col. 7, lines 29 to 37). It also may determine the relative position of a target vehicle in front of the host vehicle (same paragraph), which will include the distance from the host vehicle to the target vehicle. However, claim 1 requires that a target lane be determined by the first data processing apparatus.

The target lane is a prediction of the lane in which the host vehicle will be when it has travelled the distance. This means that at any given instance, the first data processing apparatus will predict in which lane the host vehicle will be at some future time, when it has travelled the given distance from where it is at the given instance. This lane is the target lane.

It is noted that the Examiner argues that the path projection for the host vehicle extends further than the distance to the target vehicle, and so the processor would be predicting the path of the vehicle at the distance to the target vehicle (see the section 2 on page 3 of the Office Action dated July 21, 2008). However, this is not that which is claimed. The claims require that there is a prediction of a target lane at a distance, not simply a prediction of the path the vehicle is taking. The Examiner relies on Sawamoto at column 9, line 46 to column 10, line 11 to support his argument. Appellants will deal with this portion of Sawamoto in more detail in the remarks that follow.

This portion of Sawamoto states "[the] positions of the vehicles are plotted in an absolute position system at successive times." Thus, the host vehicle Z knows its own position and that of two target vehicles P and Q. These are plotted at successive instances; no predictions are being made at this point.

This portion of Sawamoto continues, "When the [host] vehicle Z makes a lane change, the processor may determine a preceding vehicle on a historical map representing such plotted positions of the vehicles Z, P, Q. The processor may estimate a future path for the [host] vehicle Z based upon a history of movement of the front [target] vehicles P, Q." So, in this step, the processor works out which vehicle is on the projected path, and also generates a predicted path for the host vehicle. Note that there is no prediction of a target lane, only a prediction of a path which appears to be independent of lanes.

This portion of Sawamoto continues, "When making a lane change, the driver may temporarily interrupt the pursuit vehicle control mode, and may subsequently resume the pursuit mode by operating a resume switch".

This therefore teaches that the following of the target vehicle by the host vehicle can be de- and re-activated, and so appears irrelevant to the novelty of the claims.

This portion of Sawamoto continues, "Alternatively, when a lane change is made, the processor may automatically interrupt the pursuit vehicle control mode, and subsequently resume the pursuit vehicle control mode when the driver operate [sic] the

resume switch." This, again, relates to controlling whether the host vehicle follows the target vehicle, and so appears irrelevant to the novelty of the claims.

This portion of Sawamoto continues, "The vehicle control system according to the illustrated embodiment estimates a future path for its own vehicle and uses the estimated future part to determine a preceding vehicle." This again repeats the fact that the system predicts a path for its vehicle, but there is still no disclosure of determining a target lane as claimed.

This portion of Sawamoto continues, "However, the vehicle control system may be arranged to estimate a future lane for its own vehicle and use the estimated lane to determine a preceding vehicle." This is the closest Sawamoto comes to being relevant to the claimed invention. A prediction of a target lane is made, and the target lane is used to determine the next vehicle ahead of the host vehicle in that lane. However, Sawamoto is silent as to how this is achieved. As indicated above, the identical invention must be shown in as complete detail as is contained in the claim, *Richardson v Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989), and there is no such detail in Sawamoto. There is no disclosure of the fact that the target lane should be predicted by predicting the lane in which the host vehicle will be when it has travelled the distance to the target vehicle. It is not, therefore, a target lane as defined by the claim, as it does not represent a prediction of the lane in which the host vehicle will be when it has travelled the distance to the target vehicle.

When working out the target lane, the device of Sawamoto makes no consideration of the distance from the host vehicle to the target vehicle. The processor of Sawamoto can issue a lane change signal, which means that a lane change is currently happening. This is described in the first paragraph of column 8, which discusses that "the processor decides whether its own vehicle is making a lane change."

Note how this is a determination of whether a lane change is currently happening.

Similarly, the lane change signal is generated, according to column 6, lines 43 to 46, based upon the yaw rate or steering angle of the host vehicle. The lane change

signal, which is the only basis on which the processor of Sawamoto could be said to be doing any prediction of a target lane, thus has no dependency on the distance of the host vehicle to a target vehicle, and so Sawamoto is not predicting a target lane in which the host vehicle will be located when the host vehicle has travelled along the projected path by the distance to the host vehicle.

Sawamoto does not therefore disclose the first data processing apparatus claimed.

Notwithstanding the above, with respect to the second data processing apparatus claimed, the first data processing apparatus is required by claim 1 to compare the position of the target vehicle with the position of the target lane.

The device of Sawamoto does determine the position of the target vehicle. However, there is no comparison of that position with that of the target lane (that is, the lane in which the host vehicle will be when it has travelled down the projected path by the distance to the target vehicle).

The Examiner relies upon column 7, lines 38 et seq. as showing this feature; this merely describes that the processor plots the position of the target vehicle relative to the host vehicle and the projected path for the host vehicle. Column 9, lines 43 et seq. are also relied upon by the Examiner. Sawamoto describes the processor as determining a future lane for the vehicle. However, this is not a prediction of the target lane as required by the present claims, because it is not a prediction of the target lane in which the vehicle will be when it has travelled the distance to the target vehicle. Therefore, there is no comparison as required by the claims, and so Sawamoto does not disclose the second data processing apparatus claimed.

Given that two elements required by the claims are absent from the teaching of Sawamoto, the rejection of the claims as lacking in novelty is clearly inappropriate.

Accordingly, the Examiner has not shown that Appellants' argument that Sawamoto does not disclose the first data processing apparatus configured to predict a target lane in which the host vehicle will be located when it has traveled along the projected path by the distance to the target object is incorrect and in fact Appellants' arguments still hold good. Sawamoto does not disclose the first data processing

apparatus as claimed and so cannot be used to show that the claims lack novelty under 35 U.S.C. §102.

The Examiner has rejected the present independent claim 1 as lacking novelty with respect to Sawamoto.

If an independent claim is allowable, then any claim depending therefrom is allowable. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Claims 2-5, 7-14 and 17-19 depend from claim 1 and should be allowable for at least the same reasons as claim 1.

Conclusion

In view of the above remarks, Appellants have shown that the claims are in proper form for allowance, and the invention, as defined in the claims herein, is neither disclosed nor suggested by the references of record. In view of the foregoing arguments, the rejections of claims 1-5, 7-14 and 16-23 are in error, and should be reversed. Appellants accordingly respectfully request that the Board of Patent Appeals and Interferences reverse the Examiner as to all rejections.

VIII. Claims Appendix

1. A target vehicle position sensing apparatus for a host vehicle, the apparatus comprising:

a lane detection apparatus provided on the host vehicle which includes an image acquisition apparatus configured to capture an image of at least a part of the road ahead of the host vehicle;

a vehicle path estimation apparatus configured to estimate a projected path for the host vehicle;

a target vehicle detection apparatus located on the host vehicle which is configured to identify the position of any target vehicles located on the road ahead of the host vehicle, the position including data representing the distance of the target vehicle from the host vehicle;

first data processing apparatus configured to predict a target lane in which the host vehicle will be located when it has travelled along the projected path by the distance to the target vehicle; and

second processing apparatus configured to compare the position of the target vehicle determined by the target vehicle detection apparatus with the position of the target lane to provide a processed estimate of the actual position of the target vehicle.

2. The apparatus of Claim 1 in which the processed estimate comprises an indicator of whether or not the target vehicle is in the same lane as the host vehicle is projected to be in when the host vehicle has traveled along the projected path by the distance to the target vehicle.

3. The apparatus of Claim 1, in which the image acquisition apparatus of the lane detection apparatus comprises a video camera which is configured to produce at least one two-dimensional image of an area of the road in front of the host vehicle.

4. The apparatus of Claim 1 in which the at least one image is passed to an image processing unit.

5. The apparatus of Claim 4 in which the image processing unit is configured to filter the at least one image to identify artifacts in the image corresponding to at least one of the right hand edge of a road, the left hand edge of the road, lane markings defining lanes in the road, the radius of curvature of the lanes and the road, and the heading angles of the host vehicle relative to the road and lanes.

6. (Cancelled)

7. The apparatus of Claim 4 in which the image processing unit is configured to apply an edge detection algorithm to the at least one image to detect lines or curves that correspond to lane boundaries.

8. The apparatus of Claim 7 in which the image processing unit is configured to perform a tracking algorithm which employs a recursive least squares technique to identify the path of lanes in the at least one image.

9. The apparatus of Claim 7 in which the output of the image processing unit comprises data representing lane topography which is passed to the first data processing apparatus.

10. The apparatus of Claim 9 in which the output of the image processing unit also includes information including the position of the host vehicle relative to the identified lanes and its heading.

11. The apparatus of Claim 7 in which the first data processing apparatus is configured to determine which lane the host vehicle will occupy when it has travelled the distance to a target vehicle by projecting the path estimated by the vehicle path estimation apparatus and comparing the path estimated by the vehicle path estimation apparatus with lane boundary information at that distance.

12. The apparatus of Claim 7 in which the vehicle path estimation apparatus is configured to use lane information to determine which lane the host vehicle is presently travelling in.

13. The apparatus of Claim 7 in which the vehicle path estimation apparatus may estimate the path by projecting a path based upon the heading of the host vehicle.

14. The apparatus of Claim 12 in which the projected path corresponds to the path of the lane.

15. (Cancelled)

16. The apparatus of Claim 1 in which the vehicle path estimation apparatus includes a yaw sensor which is configured to determine the rate of yaw of the host vehicle in order to provide a measure of the radius of curvature of the path a vehicle is following.

17. The apparatus of Claim 1 in which the target vehicle detection apparatus comprises an emitter which emits a signal outward in front of the host vehicle and a receiver which is configured to receive a portion of the emitted signal reflected from the target vehicle or objects in front of the vehicle, and a target processing apparatus which is configured to determine the distance between the host vehicle and the target vehicle or object.

18. The apparatus of Claim 17 in which the emitter and the receiver emit and receive one of radar signals and lidar signals.

19. The apparatus of Claim 17 in which the distance between the host vehicle and the target vehicle or object is determined by the target processing apparatus based upon the time of flight of a signal from emission of the signal to receipt of a reflected portion of the signal.

20. An adaptive cruise control system for a host vehicle comprising:

sensing apparatus according to Claim 1 and signal generating apparatus configured to generate a steering bias signal which when applied to a steering system of the vehicle assists in controlling the direction of the vehicle so as to cause the host vehicle to track the target vehicle.

21. The control system of Claim 20 in which the signal generating apparatus generates at least one vehicle speed control signal which when applied to a brake system or a throttle control system of the vehicle cause the vehicle to maintain a predetermined distance behind a target vehicle.

22. The control system of Claim 20 in which at least one of the signals is generated in response to the estimate of the target position determined by the sensing apparatus.

23. The control system of Claim 20 in which the control signals are only generated for target vehicles that occupy the projected path of the host vehicle.

IX. Evidence Appendix

None

X. Related Decisions Appendix

None